NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

BUDGETING FACILITIES OPERATION COSTS USING THE FACILITIES OPERATION MODEL

by

Seth Thornhill

June 2011

Thesis Co-Advisors: Daniel Nussbaum
Raymond Franck

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** June 2011	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE Budgeting Facilities Operation Costs Using the Facilities Operation Model		**5. FUNDING NUMBERS**	
6. AUTHOR(S) LCDR Seth Thornhill, SC, USN			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000		**8. PERFORMING ORGANIZATION REPORT NUMBER**	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number N/A.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited		**12b. DISTRIBUTION CODE**	

13. ABSTRACT (maximum 200 words)

The Facilities Operation Model (FOM) is used by the Office of the Deputy Under Secretary of Defense (Installations & Environment) to estimate annual facilities operation costs for the Department of Defense. This thesis analyzes the process by which the Department of the Navy forecasts facilities operation costs and how ODUSD(I&E) uses the FOM for the same purpose. It then compares the two processes against historical data from Fiscal Year 2007–2010 to study how the DoN could use the FOM within the Program Objectives Memorandum (POM) development process. The results show the Navy would be well advised to continue its current methods to develop the POMs. The FOM is still in the process of development, and the methods used by the Navy today are providing more accurate, consistent forecasts for facility operations.

14. SUBJECT TERMS Facilities Operation Model, Base Operating Support			**15. NUMBER OF PAGES** 61
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for release; distribution is unlimited

BUDGETING FACILITIES OPERATION COSTS USING THE FACILITIES OPERATION MODEL

Seth Thornhill
Lieutenant Commander, United States Navy
B.S., US Naval Academy, 1999

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

NAVAL POSTGRADUATE SCHOOL
June 2011

Author: _____
Seth Thornhill

Approved by: _____
Dr. Daniel Nussbaum
Thesis Co-Advisor

_____
Raymond Franck
Thesis Co-Advisor

_____
William Gates
Dean, Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

The Facilities Operation Model (FOM) is used by the Office of the Deputy Under Secretary of Defense (Installations & Environment) to estimate annual facilities operation costs for the Department of Defense. This thesis analyzes the process by which the Department of the Navy forecasts facilities operation costs and how ODUSD(I&E) uses the FOM for the same purpose. It then compares the two processes against historical data from Fiscal Year 2007–2010 to study how the DoN could use the FOM within the Program Objectives Memorandum (POM) development process. The results show the Navy would be well advised to continue its current methods to develop the POMs. The FOM is still in the process of development, and the methods used by the Navy today are providing more accurate, consistent forecasts for facility operations.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

BOS	-	Base Operating Support
CNIC	-	Commander, Navy Installations Command
COLS	-	Common Output Level Standard
DECA	-	Defense Commissary Agency
DLA	-	Defense Logistics Agency
DoD	-	Department of Defense
DoN	-	Department of the Navy
FAC	-	Facility Analysis Category
FAD	-	Facilities Assessment Database
FY	-	Fiscal Year
FOM	-	Facilities Operation Model
iNFADS	-	Internet Navy Facilities Assets Data Store
NAF	-	Non-Appropriated Funding
O&M	-	Operations and Maintenance
ODUSD(I&E)	-	Office of the Deputy Under Secretary of Defense (Installations & Environment)
OPNAV	-	Office of the Chief of Naval Operations
PBIS	-	Program Budget Information System
PE	-	Program Element
POM	-	Program Objectives Memorandum
RPI	-	Real Property Inventory
SIC	-	Standard Industrial Classification
TMA	-	Tricare Management Activity
VV&A	-	Verification, Validation, and Accreditation
WCF	-	Working Capital Fund

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

This thesis would not have been possible without the help of and patience of the people working at CNIC, ODUSD(I&E), R&K Solutions, FMB, and the Navy Postgraduate School. In particular, I wish to express my gratitude to CDR Eric Hawn for providing the points of contact and direction to research this thesis, Mr. Robert Lange and Mr. John Hesson for all of their quick and detailed responses to my numerous requests for information about the Facilities Operation Model, and CDR Chris Gallagher and CDR David Kang for helping me with understanding CNIC's process for budgeting facilities operation costs. I also thank Professor Raymond Franck, my thesis co-advisor, Professor John Mutty, Professor Richard Doyle, and Professor Kenneth Euske for providing valuable feedback and encouragement. Most of all, I owe my biggest thanks to Professor Daniel Nussbaum for sharing his knowledge and expertise and being with me every step of the way throughout the thesis process.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

The Department of the Navy (DoN) manages a global real property portfolio of approximately 63,500 facilities (buildings, structures, and linear structures) located on 74 sites covering 2.1 million acres.[1] From 125 runways to 443 piers/wharfs, the DoN manages $196 billion in property assets, and this physical footprint is one of the factors that enables the Navy to fulfill its mission within the Department of Defense (DoD). Substantial resources are needed to conduct a host of activities to utilize and operate the large number of facilities spread out over the globe. The buildings require electricity and water, the bases need fire protection and emergency services, and base security provides overall protection. These resources are paid out of the Navy's Base Operating Support (BOS) account under its Operations and Maintenance (O&M) appropriation. In fiscal year (FY) 2007, facility operations or BOS required $4.2 billion.[2] In FY2012, it is estimated it will reach $4.6 billion.[3] Unlike sustainment and modernization, failure to fund facility operations results in a loss of mission capability today, not tomorrow. In a time of economic crisis, when the Navy must make critical decisions concerning where to spend resources, the choice will almost always err on allocating funding to ensure today's mission can be completed over tomorrow's. If the tools to define what amount is needed to fund today's mission are accurate, then the leadership can plan, with confidence, to invest in sustainment and modernization for tomorrow's mission without jeopardizing the present. One established method for forecasting costs is to develop a model to determine the relationships between cost and the many variables that "drive" them. Once a model has been developed, it undergoes a Verification, Validation, and Accreditation (VV&A) process. Upon passing VV&A, its use provides an established method of forecasting costs and a framework for planners to justify their budget decisions.

[1] ODUSD(I&E), "Base Structure Report Fiscal Year 2010 Baseline," Navy-21.

[2] Department of the Navy, "Fiscal Year 2009 Budget Estimates: Operations and Maintenance," 255.

[3] Department of the Navy, "Fiscal Year 2012 Budget Estimates: Operations and Maintenance," 286.

A. BACKGROUND

In 2004, the Office of the Deputy Under Secretary of Defense (Installations & Environment) – ODUSD(I&E) – published the *Defense Installations Strategic Plan*. Updated in 2007, the plan outlined five goals to guarantee installation assets and services would be available to support DoD missions throughout the globe with all necessary joint capabilities and requirements. Goal Four of that plan was "Right Resources: Balance resources and risks to provide high quality installation capabilities and to optimize life-cycle investments to support readiness."[4] Recognizing that requirements continuously outnumber resources, DoD needed a process of establishing priorities and assessing the risks of not meeting requirements in order to balance resources and requirements for installation assets. The first objective under that goal was to standardize cost requirements to "operate, sustain, and modernize federally funded DoD facilities." Three models were created to meet that objective. They were the Facilities Sustainment Model, the Facilities Recapitalization Metric, and the Facilities Operation Model. The Facilities Sustainment Model estimates the level of investment needed to provide routine facility maintenance and recurring, schedulable repairs. The Facilities Recapitalization Metric provides the means for tracking facility recapitalization rates on investments to replace or renovate facilities. The Facilities Operation Model (FOM) was designed to enable budget planners to identify the costs associated with operating DoD facilities. Facility operations encompasses a large variety of different activities. In the DoD, it includes activities from airfield operations (aviation fuel support and cargo handling, for example) to base security to family housing. The FOM narrows the scope of facility operation costs to the following ten primary functions, common to all installations:

- Fire and Emergency Services
- Utilities (energy and water/waste water)
- Pavement Clearance
- Refuse Collection and Disposal

[4] ODUSD(I&E) (2007), "Defense Installations Strategic Plan," 20.

- Real Property Leases
- Grounds Maintenance and Landscaping
- Pest Control
- Custodial
- Real Property Management & Engineering Services
- Readiness Engineering

A more detailed description for each of the ten primary functions can be found in Appendix A. The FOM is designed around the Future Years Defense Program (FYDP) structure for use as a budgeting tool, and as a result, its purpose is to forecast costs within the Facilities Operation program element (PE ***79).

B. PURPOSE

Currently, the DoN does not use the FOM to budget costs, but instead is in the process of developing its own models to use as budgeting tools. If the FOM provides accurate forecasts for facilities operation costs for DoN installations, the DoN may be duplicating an effort that has already been accomplished by ODUSD(I&E). This thesis looks at the process used by the DoN to forecast facilities operation costs, how ODUSD(I&E) uses the FOM for the same purpose, and compare the two processes against historical data to determine how the DoN should use the FOM within the Program Objectives Memorandum (POM) development process.

C. RESEARCH QUESTIONS

Primary Question:

Does the FOM provide relevant and useful forecasts for use as a DoN budgeting tool?

Secondary Questions:

1. How accurate have the FOM forecasts been?

2. Is the FOM better than past/current methods used by DoN to forecast facilities operation costs?
3. In what ways can the FOM be improved?

D. METHODOLOGY

This thesis uses historical data from the Program Budget Information System (PBIS) for facility operations from the past three years to compare actual execution dollars to the modeled output from the FOM. The objective is to determine the accuracy of the FOM forecasts using historical cost. A comparison is also made to the methods used by DoN for estimating facilities operation cost with the same historical data to find parallels or differences between the FOM and the DoN methods.

II. PAST AND CURRENT METHODS IN DON FOR ESTIMATING FACILITIES OPERATION COSTS

Prior to the past ten years, the DoN used an incremental approach to build its facilities budgets for future years. This method consisted of using the prior year's budget amount as a starting point, applying an inflation factor, and then soliciting input from the stakeholders as to what changes needed to be incorporated into the new budget. This approach depended heavily on the budget planners having an intimate knowledge of their different programs and their ability to produce accurate cost estimations. Some planners developed models to forecasts costs, but those models varied in quality and lacked accreditation. "Prior to FY-04, some Navy [Planning, Programming, Budgeting, and Execution] PPBE stakeholders used detailed but unaccredited models to develop Program Objective Memorandum/Program Review (POM/PR) input while others relied on budgetary level-of-effort projections for this purpose."[5] In 1999, the DoN created a policy requiring all models and simulations being used in the DoN to undergo a Verification, Validation, and Accreditation (VV&A) process in order to use them.[6] In 2003, DoN centralized all Navy shore installation management including facility operations and sustainment under one organization— Commander, Navy Installations Command (CNIC). CNIC immediately started developing the Base Operating Support (BOS) program that would break down facility operations into 32 activities / Standard Industrial Classification (SIC) codes (see Figure 1).

[5] OPNAVINST 5200.35, 2.

[6] SECNAVINST 5200.40, 3–4.

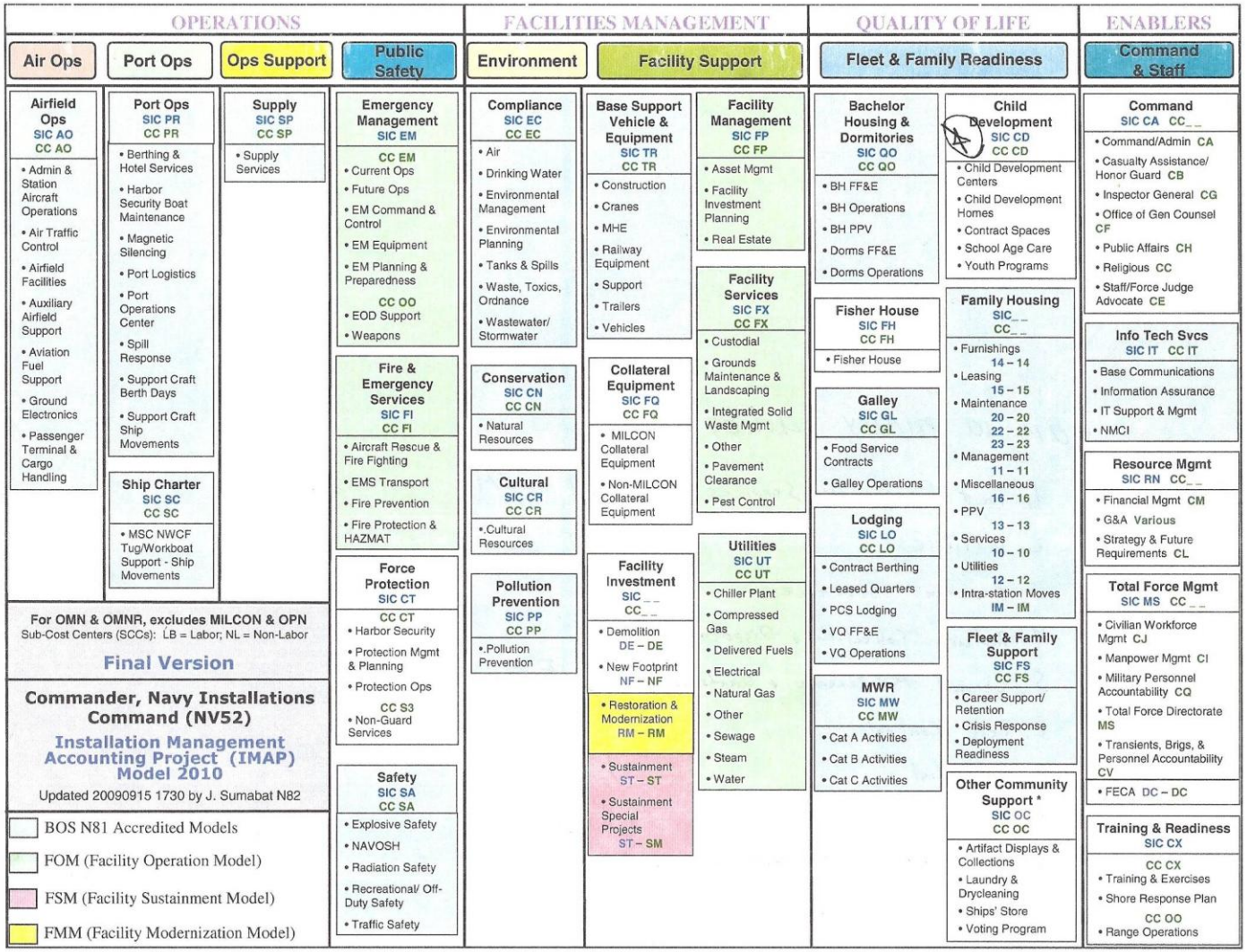

Figure 1. Components of Base Operating Support

In 2006, the DoN shifted away from the incremental approach to budgeting and directed all Navy resources in operating appropriations to be justified using accredited models.[7] CNIC began developing specific models for the 32 SICs, and each model would have to pass the VV&A process before it could be used to generate requirements. One of the key prerequisites for full accreditation is a results validation where the modeled output is compared to the actual execution. If a model developed for testing in 2007 was used to forecast requirements for FY2009, the numbers for actual execution would not be known until FY2010-2011. Every model requires calibration, and as a result, the first two years of comparing forecasts versus actuals are used to troubleshoot and improve the model. For functions such as utilities discussed in this thesis, CNIC forecasted facilities operation costs based on the inputs provided by its subordinate regional commanders, who in turn based their estimates on the inputs provided by their installation commanders. "The unit requirements and unit costs for each commodity [electrical, steam, natural gas, water, etc.] were generated at the installation or regional level, validated by regional program managers and provided to OPNAV [Office of the Chief of Naval Operations] via a web-based data call."[8]

The CNIC models are designed to include a matrix to match desired performance levels. A model that can output not only what amount of funding is required to fulfill 100% of the requirement, but what level of service can still be maintained at 75% or even 50% of the requirement is very useful for budget planners, especially if they are fiscally constrained from funding 100% of the requirement. The SIC models are designed to output a requirement based on a desired performance level, broken down into four Common Output Level Standards (COLS). The highest level of service is COLS 1 with the lowest being COLS 4. The COLS provide a framework of standards and definitions for each performance level, allowing the budget planners to have more flexibility in determining how much to fund activities throughout the different regions. In a situation where budget cuts must be made, the COLS system is used to determine what level of service will be lost when downgrading and provides a precise amount of savings for the

[7] OPNAVINST 5200.35, 2.

[8] CNIC, "N46 Ashore Readiness POM-10 Capability Plan, Utilities." 24 April 2008, 5.

lower standard of performance. Once CNIC has determined what COLS will be used, it develops the request amount for facilities operation funding and includes that amount in CNIC's total request for funding, also known as the POM for CNIC. That POM will be forwarded to the upper echelons of the DoN and DoD for review and approval. Ultimately it will be included in the President's budget request to Congress, where it is debated and approved (though not always the same amount as requested) in the annual Defense authorization and appropriation bills.

III. BREAKDOWN OF THE FACILITIES OPERATION MODEL (FOM)

The FOM takes a series of inputs and generates an output that is designed to show what dollar amount is required to fund the ten primary activities at 100% of the requirement. This section matches each FOM function to its Navy BOS counterpart and provides an explanation for how the FOM calculates its requirement.

As seen in Table 1, the ten primary activities within the FOM correspond to five of the 32 SICs within BOS. The following table matches the FOM activity to its BOS counterpart:

Table 1. FOM Primary Activities Aligned to the Navy Base Operating Support SICs

FOM ACTIVITY	BOS SIC	Description
Fire and Emergency Services	FI	Fire & Emergency Services
	EM	Emergency Management
Utilities (energy and water/waste water)	UT	Utilities
Pavement Clearance	FX	Facility Services
Refuse Collection and Disposal	FX	
Grounds Maintenance and Landscaping	FX	
Pest Control	FX	
Custodial	FX	
Real Property Leases	FP	Facility Management
Real Property Management & Engineering Services	FP	
Readiness Engineering	N/A	Not applicable

The FOM activity Fire and Emergency Services corresponds to two of the SICs (FI and EM), whereas FX captures five of the FOM activities.

To build its forecasts, the FOM utilizes the following basic formula to forecast each of the ten primary functions:

Requirement = Quantity * Cost Factor * Location Index

The three factors are explained in the following sections.

A. QUANTITY

Each component of the DoD produces a Real Property Inventory (RPI) report at the end of each fiscal year. The RPI lists every facility and property within the DoD to include what type of asset it is, its size, and what component manages it. The FOM uses all of the RPIs from the different DoD services to create a database of the assets, called the Facilities Assessment Database (FAD). The FAD consolidates the RPIs into a common, specified format known as the Facility Analysis Category (FAC) and represents over 700,000 facilities at 7,900 locations. Each FAC is assigned a location index and matched with an organization that will provide funding for any operational requirements. The most common unit of measure for the facilities is square feet. To calculate the Custodial function, for example, the formula would access the FAD to obtain the square footage for each facility to be included in the calculation and multiply it by the cost factor and location index to find the requirement amount in dollars. The Fire and Emergency Services function uses population data rather than square feet as its unit of measure to calculate the requirement. DoD components also include in the RPI future changes such as base closures or new construction that are expected to occur during the period being forecasted in the FYDP in order to achieve more accurate results.[9]

B. COST FACTOR

Each FOM function within the FOM has associated cost factors assigned to them based on the type of facility or FACs. The cost factors are based to the maximum extent possible on commercial standards and benchmark costs for similar facilities found in the private sector. Examples of sources that provided the data to construct the cost factors came from Whitestone Research, Building Owners & Managers Association

[9] R&K Solutions, "Facilities Operation Model, User's Manual, Version 12 (FY2012–2017)," 12–14.

International, and Urban Land Institute. For facilities not replicated in the private sector, the cost factors were derived from Service-validated sources and historical costs. The FOM Configuration / Support Panel is made up of representatives from the four services, OSD, the White House staff, the Defense Logistics Agency, the TriCare Management Activity, the DoD Educational Activity, and the Defense Commissary Agency. This panel annually reviews and approves the cost factors for inflation and changes in how they are computed. It should be noted the FOM is not designed for a cost factor to be accurate for a specific facility in a single region, but rather for all of the same facility types on a macro level.[10]

C. LOCATION INDEX

Each DoD site world-wide is assigned a unique location index (LI) to adjust the FOM function for differences in climate and geography. Areas that have heavy snow and ice receive a higher LI than those that do not in order to account for more expensive labor, materials, and equipment that would be used in one of the FOM function such as pavement clearance. The only FOM function that does not use a LI is energy, which is based on local costs for fuel and electricity.

D. SPECIAL BILLS

Some military activities are so unique they cannot be accurately modeled. The following are examples of facilities operation costs that must be entered manually:

- Disaster preparedness and response
- Engineering Readiness for the Air Force
- Accomplishing Utility Privatizations

The inputs for these activities are entered by the services as non-modeled costs (special bills).[11]

Figure 2 provides a graphic representation of the overall process of how the FOM calculates the dollar requirement.

[10] R&K Solutions, "Facilities Operation Model, User's Manual, Version 12 (FY2012–2017)," 14–15.

[11] R&K Solutions, "Facilities Operation Model, User's Manual, Version 12 (FY2012–2017)," 10.

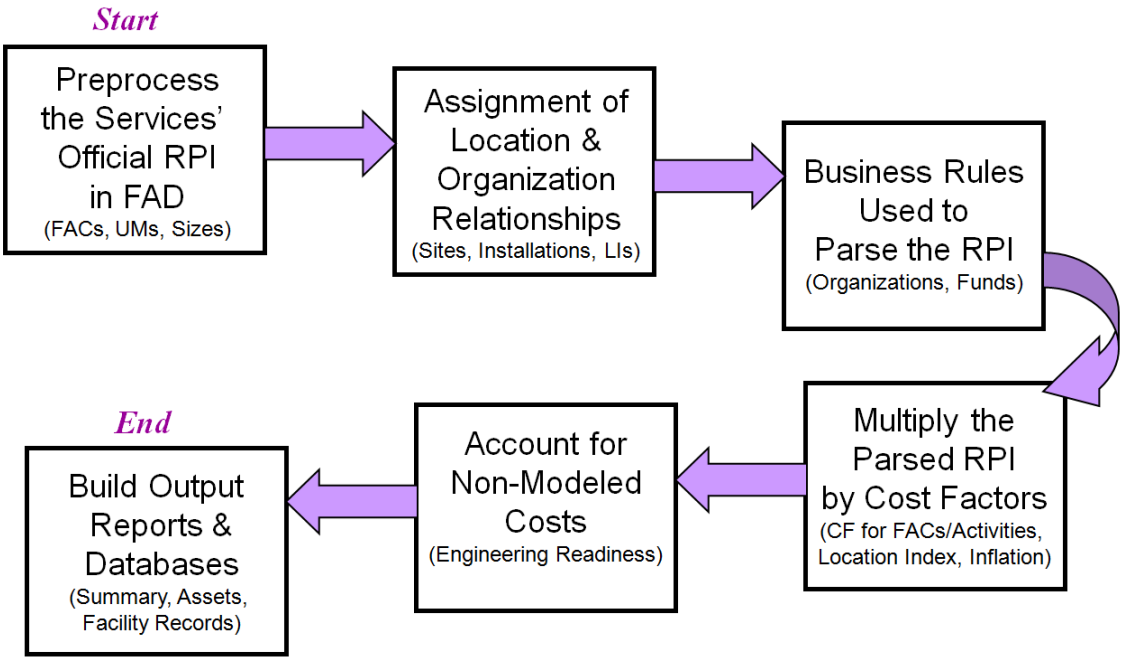

Figure 2. Description of the FOM Process[12]

[12] R&K Solutions, "Facilities Operation Model, User's Manual, Version 12 (FY2012–2017)," 12.

IV. ANALYSIS OF THE FOM

The next step is to compare the FOM forecasts for how much it should cost the Navy to provide each of the ten primary functions for its facilities against the historical costs. The historical costs are from the Program Budget Information System (PBIS), the database used by the Navy to track budget execution dollars.

A. PRESENTATION OF HISTORICAL BUDGETED COST DATA FROM PROGRAM BUDGET INFORMATION SYSTEM (PBIS)

Table 2 shows the actual budget dollars from the PBIS database that were spent during fiscal years 2007–2010 on the listed Base Operating Support SICs: The data shows only the PE***79 of the SICs since the FOM only bases its requirements forecast on that PE.

Table 2. PBIS data for Navy O&M PE205079, FY2007-2010 (as of February 2011, TY$M)

APPN	BSO	LI	SI	SI_LABEL	PE	2007	2008	2009	2010
OMN	52	BSS1	EM	Emergency Management/Disaster Preparedness	0205079N	$ 60.10	$ 86.39	$ 88.28	$ 69.70
OMN	52	BSS1	FI	Federal Fire	0205079N	$ 264.57	$ 293.88	$ 303.49	$ 314.34
OMN	52	BSS1	FP	Facilities Management	0205079N	$ 252.71	$ 315.04	$ 301.51	$ 350.57
OMN	52	BSS1	FX	Facilities Services	0205079N	$ 310.25	$ 262.75	$ 242.00	$ 255.74
OMN	52	BSS1	UT	Utilities	0205079N	$ 722.44	$ 796.42	$ 800.76	$ 851.50
						$1,610.06	$1,754.48	$1,736.04	$1,841.85

B. FOM FORECASTS FOR FY2007–2010

An explanation of how the FOM requirements were converted in order to compare them to PBIS is contained in Appendix B. Key features of the FOM require special attention. The FOM generates a dollar amount for the cost to perform an activity such as fire fighting and road clearance, but it does not account for who performs the task. If active duty personnel perform the task, their salary comes out of the MILPERS appropriation, not O&M. In this case, the labor cost of performing the task would appear in the FOM requirement, but would not be accounted for in the PBIS historical data because MILPERS is not included in the PBIS database. If contractors are performing

the work, the contract for that task may only be a part of the overall contract. If that overall contract is primarily a sustainment or modernization contract, it is possible the operations cost could be included with the sustainment costs under a different funding code (PE***78) and not be accounted for in PE***79. As in the previous case, the PBIS data would not account for the facility operations cost miscoded under a different PE. The primary data sources for the FAD are the component services' RPI reports. The FOM depends on the accuracy of the RPIs, as any errors in the reports will get carried forward in its calculations.

Table 3 shows the 2007-2010 FOM requirements, using the methodology as explained in Appendix B:

Table 3. FOM Forecasts for U.S. Navy, Active Duty (TY$M)

	2007	2008	2009	2010
Fire and Emergency Services	$ 279.77	$ 325.45	$ 328.72	$ 339.15
Utilities	$ 629.44	$ 658.43	$ 711.08	$ 404.40
Pavement Clearance	$ 5.38	$ 10.40	$ 12.24	$ 5.82
Refuse Collection and Disposal	$ 22.38	$ 37.72	$ 49.92	$ 13.83
Grounds Maintenance and Landscaping	$ 41.44	$ 67.56	$ 96.11	$ 80.94
Pest Control	$ 6.08	$ 9.33	$ 10.07	$ 6.03
Custodial	$ 76.47	$ 105.77	$ 143.76	$ 68.28
Real Property Leases	$ 18.87	$ 102.93	$ 89.47	$ 43.84
Real Property Management	$ 122.57	$ 261.86	$ 231.96	$ 238.98
	$ 1,202.40	$ 1,579.45	$ 1,673.32	$ 1,201.26

The FOM does not give different budget amounts for varying levels of service. Instead, it generates a single number that represents what it will cost to fully fund that activity. In FY2007, for example, FOM estimated it would cost the Navy $279.77 million to provide fire and emergency services for all of its active duty commands.

C. COMPARISON BETWEEN FORECAST RESULTS AND HISTORICAL COSTS

Table 4 and Figure 3 compare the actual costs from the PBIS database as of February, 2011 against the FOM forecasts for FY2007-2010. Table 5 displays the monetary and percentage differences between FOM and PBIS.

Table 4. FOM Forecasts and PBIS data for U.S. Navy, Active Duty (TY$M)

	2007		2008		2009		2010	
	FOM	PBIS	FOM	PBIS	FOM	PBIS	FOM	PBIS
Fire and EM	$ 280.00	$ 324.67	$ 325.45	$ 380.26	$ 329.00	$ 391.77	$ 339.15	$ 384.04
Utilities	$ 629.00	$ 722.44	$ 658.00	$ 796.42	$ 711.00	$ 800.76	$ 404.00	$ 851.50
Facility Services	$ 152.00	$ 310.25	$ 231.00	$ 262.75	$ 312.00	$ 242.00	$ 175.00	$ 255.74
Facility Management	$ 141.00	$ 252.71	$ 365.00	$ 315.04	$ 321.00	$ 301.51	$ 283.00	$ 350.57
TOTAL	$ 1,202.00	$ 1,610.06	$ 1,579.00	$ 1,754.48	$ 1,673.00	$ 1,736.04	$ 1,201.00	$ 1,841.85

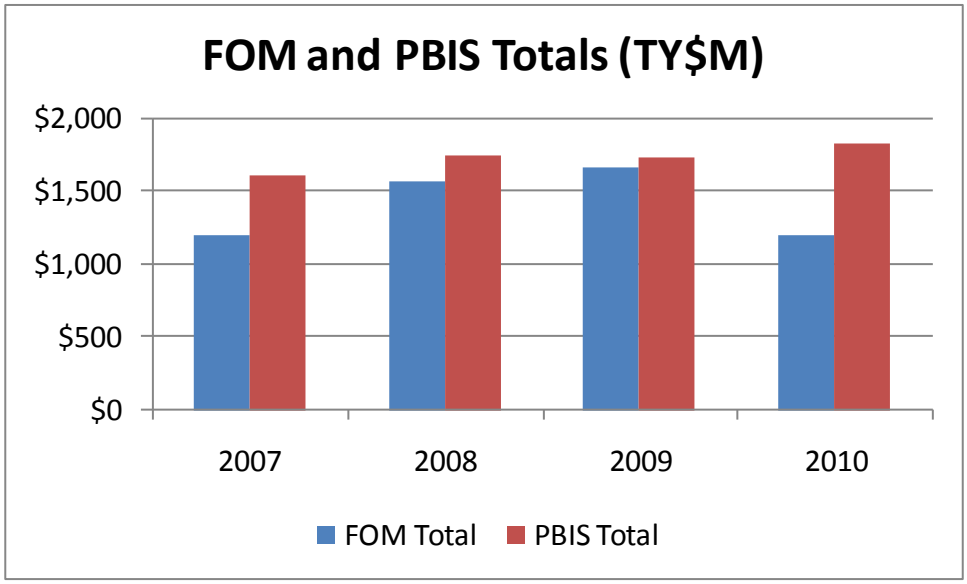

Figure 3. FOM Forecast Totals and PBIS data for U.S. Navy, Active Duty

Table 5. Deltas between the FOM Forecasts and PBIS data for U.S. Navy, Active Duty (TY$M)

	2007		2008		2009		2010	
	Δ$	Δ%	Δ$	Δ%	Δ$	Δ%	Δ$	Δ%
Fire and EM	$ (44.67)	-14%	$ (54.81)	-14%	$ (62.77)	-16%	$ (44.90)	-12%
Utilities	$ (93.44)	-13%	$ (138.42)	-17%	$ (89.76)	-11%	$ (447.50)	-53%
Facility Services	$ (158.25)	-51%	$ (31.75)	-12%	$ 70.00	29%	$ (80.74)	-32%
Facility Management	$ (111.71)	-44%	$ 49.96	16%	$ 19.49	6%	$ (67.57)	-19%
TOTAL	$ (408.06)	-25%	$ (175.48)	-10%	$ (63.04)	-4%	$ (640.85)	-35%

Note: Δ% calculated by (FOM - PBIS) / PBIS

The actual costs reflected in PBIS range from $1.6–$1.8 billion with a general trend upwards over the four year period. The FOM forecast also trends upward until 2010, when it drops $536 million from the 2009 FOM forecast. The percentage difference between the FOM forecast and the historical expenditures for DoN facilities

operation decrease over time and reaches the lowest difference of 4% in 2009. In 2010, the FOM forecast underestimates actual expenditures by 35%. The next step is to examine each category to find how FOM and PBIS compare at the function level and why the FOM differed so greatly in 2010.

Figure 4 charts the FOM forecast against budgeted cost for Fire and EM:

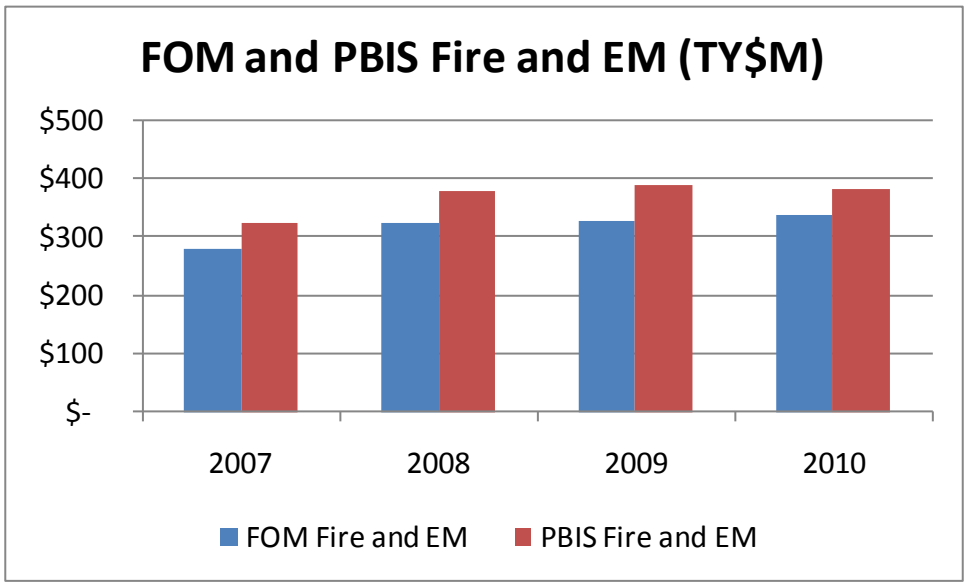

Figure 4. Fire and Emergency Services, FOM and PBIS for U.S. Navy, Active Duty

The FOM forecast is consistently lower than the PBIS budgeted costs by $45–$63 million or 12–16%. The largest difference of $63 million occurs in 2009. Per the FOM User's Manual[13] and conversations with R&K Solutions[14] (the developers of the FOM), FY2009 is the last year FOM used square feet as its unit of measure to calculate the cost factor for firefighting services. Starting with 2010, the cost factor used installation population statistics to calculate the requirement, resulting in a 12% difference between FOM and PBIS, the lowest percentage difference during the four-year period.

For utilities, Figure 5 compares the FOM forecast for utilities against PBIS historical costs:

[13] R&K Solutions, "Facilities Operation Model, User's Manual, Version 12 (FY2012–2017)," 8.

[14] Assistant Director R&K Solutions. Interview, 30 March 2011.

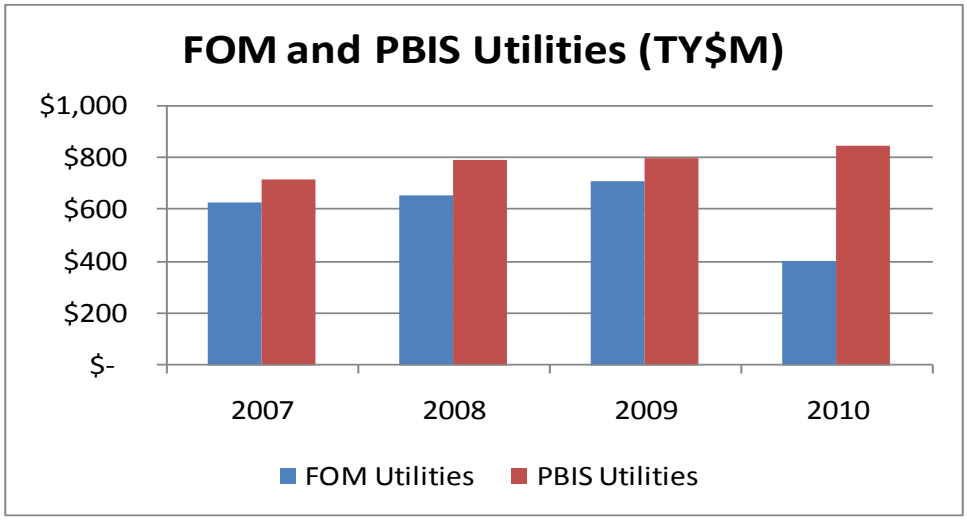

Figure 5. Utilities, FOM and PBIS for U.S. Navy, Active Duty

Until 2010, the FOM and PBIS show consistent trends as they both increase over time with the FOM being 11%–17% lower than PBIS. In 2010, the FOM is 53% lower than PBIS. As with the Fire and Emergency service cost factor, the utilities cost factor was modified for the 2010 requirement to place greater emphasis on the local cost of gas and electricity and how the local climate would affect that cost.[15] Based on the new methodology for calculating utilities, the FOM requirement drops $325 million from 2009 to 2010.

Figure 6 compares the FOM forecast for facility services (grounds maintenance, pavement clearance, etc.):

[15] Assistant Director R&K Solutions. Interview, 30 March 2011.

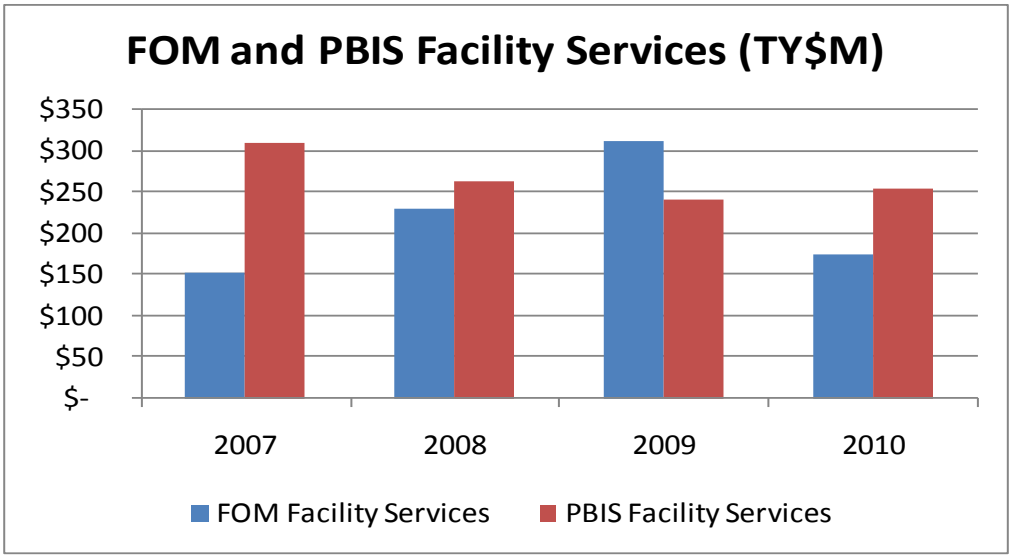

Figure 6. Facility Services, FOM and PBIS for U.S. Navy, Active Duty

The FOM has the highest difference in the first year of its usage in 2007, where it is off by $158M or 50% of PBIS. The FOM reaches its lowest difference in 2008, but overestimates in 2009 by 29% and then underestimates in 2010 by 32%. The FOM and PBIS trends are directly opposite. From 2007–2009, PBIS has a downward trend and spikes up in 2010, whereas the FOM has an upward trend until 2010 when it drops dramatically by 46% or $179M from what it forecasted in 2009. It is almost as if the FOM forecasted PBIS would continue to drop for 2010 as it did from 2007–2009, but instead PBIS increased. One possible reason for the large disparity in facility services may be this activity is the most labor intensive of the five activities. Facility services include pavement clearance, ground maintenance, pest control, custodial work, and refuse collection. The FOM forecast is based on commercial benchmarking, i.e., what it will cost a private company to have the same service performed on a similar facility. It forecasts the cost to accomplish these tasks and does not indicate who actually performs these tasks. As the years progress and the number of base closures increases, less facility services are required; however, as joint basing increases, which DoD component pays for which service changes. For example, if the Navy command on Yongsan Garrison in South Korea relocates its headquarters to Busan, the RPI database has to be updated to

reflect the Navy should no longer be charged the cost of operating their former facility; otherwise, the FOM will continue to charge the cost of those services to the Navy.

Figure 7 is facility management for FOM and PBIS:

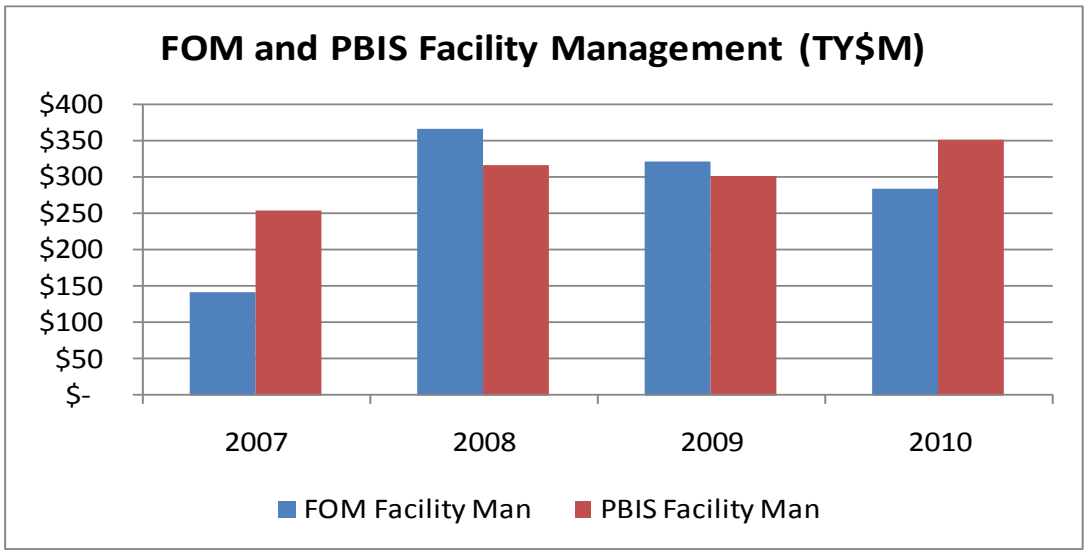

Figure 7. Facility Management, FOM and PBIS for U.S. Navy, Active Duty

PBIS has a general trend upwards for the four year period, while the FOM increases dramatically in 2008 from the 2007 forecast, but falls each year after that. The closest it comes to PBIS is in 2009, with a 6% difference, falling to a -19% difference in 2010. The methodology to calculate real property leases changed from 2009 to 2010 from using general/empirical factors (such as a percent of replacement value) to having the requirement being entered manually for what the Navy expected real property leases to cost.[16]

For a statistical approach to find a goodness-of-fit for FOM and PBIS data, a simple linear regression was conducted between the FOM forecasts and PBIS data for each function. Table 6 shows the results of the regression as well as other statistical measures such as correlation and mean error.

[16] Assistant Director R&K Solutions. Interview, 30 March 2011.

Table 6. FOM / PBIS Goodness-of-Fit

FOM / PBIS	R-Squared	F-Test	D.F.*	Correlation	Mean Error ($M)	Mean Error %	Standard Error ($M)
Fire and EM	0.932	0.035	3	0.965	$52	14.0%	$10
Utilities	0.333	0.423	3	-0.577	$192	23.5%	$53
Facility Services	0.568	0.246	3	-0.754	$85	31.0%	$24
Facility Man.	0.474	0.311	3	0.698	$62	21.3%	$36
Totals	0.010	0.899	3	0.101	$322	18.5%	$116

* D.F. = degrees of freedom

In regression analysis, having an F-test p-value lower than 0.1 and an R-squared value greater than 0.9 are considered positive goodness-of-fit measures. Only Fire and Emergency Services (highlighted in Table 6) matches these criteria. That function also has the highest correlation value. Correlation (a measure of how well two variables are related) can be between 1 and -1 with 0 meaning no relationship at all. The FOM forecast should ideally be highly correlated to PBIS, but only Fire and EM has a high correlation value above 0.90. The totals, on the other hand, have the worst values for all measures except mean error percentage. From a statistical standpoint, the FOM total has very little value in predicting the PBIS total value. This is troubling since the FOM is trying to forecast what the PBIS value will be, and only the Fire and EM function has a meaningful relationship to the actual costs in PBIS. The complete regression analysis tables can be found in Appendix C.

The large disparity in 2010 between FOM and PBIS as seen in Figure 3 resulted predominantly from the $447.5 million difference in utilities. This totals 70% of the $641 million difference between FOM and PBIS totals. Utilities is the largest activity within the FOM, accounting for 45% on average of the total requirement. Fire and Emergency Services is the second largest, making up 23% on average of the total requirement. Thus, a disparity in utilities has a much larger effect on the total difference between the FOM forecast and PBIS than any of the other activities. The FOM represents the 100% requirement of what utilities and grounds maintenance would cost a commercial entity. The primary assumption of the FOM is the cost to perform a function in the private sector should be comparable to the cost to perform the same function within the DoD. Within the DoN, the level of performance is defined by the COLS, but it is not clear how to translate the cost to perform a FOM function in the private sector to a DoD standard. For the four activities funded over the four years, only three times was FOM

higher than PBIS. The other thirteen instances, PBIS was higher than FOM. For FY2007-2010, the Navy funded the five SICs modeled by FOM at COLS 3. For the FOM to be lower than PBIS means one of the following: (1) the private sector standard is roughly equivalent to COLS 4—the lowest standard of performance for the Navy, (2) the costs to perform the same function in the Navy are higher than it is in the private sector, (3) the FOM does not fully account for the differences in the cost to perform a FOM function between the private sector and the DoN, or (4) a combination of these reasons. The fourth choice is the correct one. Many of the military installations and the facilities on them are decades old and lack the energy efficient practices that today's modern buildings have built into them. Several factors can change from the time the requirement is generated to when actual expenditures are made. The official inventory of real property may grow or decrease, the assignment of who is paying for what service may differ, and the proportion of how much is paid by O&M, WCF, and NAF may fluctuate. The FOM uses local utility costs to calculate its requirement, but they also may vary drastically. The FOM could not account for the sharp increase in the cost of oil and gasoline from 2010 to 2011 when it generated its 2011 requirement in 2009. The FOM is completely dependent on the accuracy of the RPIs submitted by the services. The Navy estimated the accuracy of its real property inventory system or iNFADS (internet Navy Facilities Assets Data Store) to be 80-85% accurate in 2008.[17] The Navy is currently working on improving the accuracy of that database and forecasts achieving audit readiness for its real property inventory by 2014.[18] The inaccuracies that existed in the database from FY2007-2010, however, would lead to miscalculations in the FOM forecast. For FY2007-2010, if the Navy had been funded based on the FOM, facilities operation would be funded at the amount the Navy considers to be its lowest standard of performance and its ability to meet mission requirements would be critically jeopardized.

[17] CNIC, "N46 Ashore Readiness POM-10 Capability Plan, Facilities Management," 25 April 2008, 15.

[18] USD (Comptroller), "Financial Improvement and Audit Readiness Plan," 30 March 2009, 40.

THIS PAGE INTENTIONALLY LEFT BLANK

V. COMPARISON BETWEEN PAST/CURRENT DON METHODS AND THE FOM

The POM amounts shown in Table 7 and Figure 8 are what the Navy requested for facilities operation funding for FY2010. Like the FOM, the POM represents a requirement for facilities operation, but it was generated by the DoN using the methods explained in Section II of this thesis.

Table 7. FY2010 FOM, PBIS, and POM for U.S. Navy, Active Duty (TY$M)

	2010						
	FOM	PBIS	POM	FOM Δ$	FOM Δ%	POM Δ$	POM Δ%
Fire and EM	$ 339.15	$ 384.04	$ 419.50	$ (44.90)	-12%	$ 35.46	9%
Utilities	$ 404.00	$ 851.50	$ 881.94	$ (447.50)	-53%	$ 30.44	4%
Facility Services	$ 175.00	$ 255.74	$ 236.52	$ (80.74)	-32%	$ (19.22)	-8%
Facility Management	$ 283.00	$ 350.57	$ 486.90	$ (67.57)	-19%	$ 136.34	39%
TOTAL	$1,201.00	$1,841.85	$2,024.86	$ (640.85)	-35%	$ 183.01	10%

Note: Δ% calculated by (FOM - PBIS) / PBIS and (POM - PBIS) / PBIS

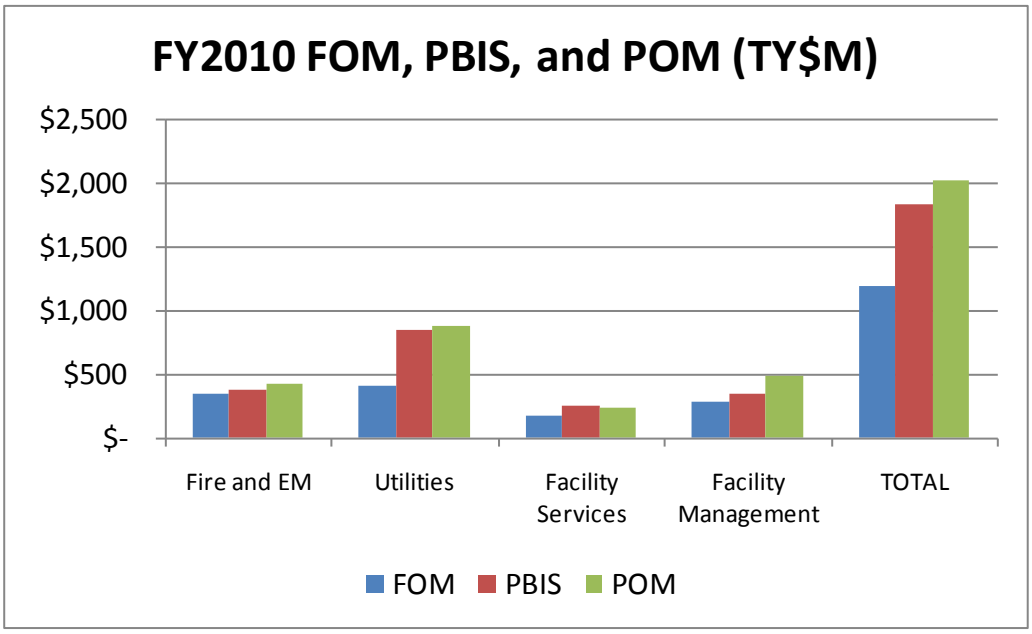

Figure 8. FY2010 FOM, PBIS, and POM for U.S. Navy, Active Duty

The FOM is different from the POM budget request even though they both represent the budget requirement. The POM request for utilities is twice the size of the FOM. As stated earlier, the FOM represents what it would cost a private sector company to use electricity, grounds keeping, emergency services, etc. for comparable facility types to DoD. The POM requirement is generated specifically for military facilities by the service components at the installation level. POM uses historical cost metrics and guidance from the upper echelons of higher command as the basis of its requirement. The Navy increased its utility funding in order to comply with the Energy Policy Act of 2005 and provide for the costs of the older facilities.[19] The FOM would not be able to account for changes in policy or for the age and lack of energy efficient facilities within the DoN because it is based on commercial benchmarks. For all of the function, the FOM forecasts the requirement below what PBIS reports as actual costs.

Except for Facility Services, the POM requirement is larger than PBIS. The difference between budget request (POM) and budget spent (PBIS) is less than 10% except for facility management. This difference, however, will grow smaller as more expenditures and outlays are executed until the FY2010 account is closed on September 30, 2015. Also, if Congress did not appropriate enough funding to match the Navy's facilities operation request, the Navy cannot spend more than appropriated by Congress, even if that amount is lower than what was requested.

[19] CNIC, "N46 Ashore Readiness POM-10 Capability Plan, Utilities," 24 April 2008, 12.

VI. CONCLUSIONS AND RECOMMENDATIONS

For now, the DoN should continue to use its current methodology in developing its budget forecasts and use the FOM only as a back-up tool to compare and contrast its requirements against. The most significant drawback to using the FOM for DoN budgeting purposes is its inconsistency when comparing the FOM forecasts to actual costs. Table 5 indicates the FOM ranges from -4% to -35% against actual facility operations cost in PBIS, which is too great a range for accurate budget planning. The only consistent trend is in Fire and Emergency Management. Budget analysts could use the FOM in future years and plan on actual costs being 12–16% higher than the FOM forecast, provided the Navy continues to fund Fire and EM at COLS 3. The other functions, however, do not have consistent trends. Facility services forecasts fluctuate from being 12% lower than actual costs in 2008 to being 29% higher in 2009 and then 32% lower in 2010.

The FOM is still relatively new, and like all new models, its forecasting methodology is still evolving, such as how to forecast utilities and fire services changed from 2009 to 2010. The following summarize the leading factors explaining differences between the FOM and actual costs in PBIS:

- Inaccuracies within iNFADS — the FOM pulls the real property inventory records from iNFADS to build its database of Navy facilities to be multiplied by the cost factors and location indices and calculate the requirements. Miscoded facility types, incorrect building dimensions, and wrong funding organization assigned are examples of errors that would be carried forward into the FOM calculation. As the Navy continues to improve the accuracy of iNFADS, the FOM will be better able to forecast requirements.
- Accounting for direct labor — the FOM generates the requirement to perform the function of fire protection and pest control, but it does not indicate who performs the service, whether it is military or contract labor. If military personnel perform the service, the labor cost would not be accounted for in PBIS. If contractors perform the service, but the funding code for their labor is not coded under PE***79, the labor cost

would also not be shown as being funded under facility operations. The FOM is not able to account for who performs each function since all four service components have different standards for what labor type performs the service at any given installation. The mix of uniform servicemen to contract labor providing fire protection at Fort Bragg may not be the same as that of NAS Jacksonville or Camp Pendleton. As a result, the FOM cannot distinguish between the cost of the requirement and the portion performed by military or contract labor.

- Based on commercial benchmarks — the cost factors used in the FOM are "derived, as much as possible, from commercial standards or typical civilian practices."[20] The key assumption of the FOM is the costs to perform a function at a commercial building should be similar to the cost to perform the same function at a military facility. If military facilities have older buildings, less energy efficient practices, and less modernization than civilian facilities, the key assumption starts to break down. A separate analysis should be conducted to investigate the differences between the cost of facility operations for the private sector and military installations. For instance, electricity and lawn care services should not be vastly different between a corporate headquarters and a military office building of similar size within the same region. However, if the vast majority of military buildings are inefficient, older, and less modernized than corporate buildings, there will be significant differences, particularly in the cost of utilities, which is the largest function within the FOM, roughly 45% of the total requirement.

At this time, the current measures the DoN uses for building POMs are providing more accurate, consistent numbers than the FOM. If the FOM had higher correlation numbers to PBIS, better regression values, and smaller mean error percentages, it would be a better candidate for the Navy to use as a budgeting tool. A similar analysis to the one performed in this thesis should be performed three to four years from now to assess how the FOM has progressed in its methodology to forecast facilities operation costs as well as compare it to the models currently being developed by the DoN.

[20] R&K Solutions, "Facilities Operation Model, User's Manual, Version 12 (FY2012–2017)," 8.

LIST OF REFERENCES

Assistant Director Hesson, John. (2011, March 30). R&K Solutions. (S. Thornhill, Interviewer)

Commander, Navy Installations Command. (2008, April 25). N46 Ashore Readiness POM-10 Capability Plan, Facilities Management. Washington D.C., USA.

Commander, Navy Installations Command. (2008, April 24). N46 Ashore Readiness POM-10 Capability Plan, Utilities. Washington D.C., USA.

Department of the Navy. (2008, February 1). *Fiscal Year 2009 Budget Estimates: Operations and Maintenance, Volume 1.* Retrieved February 15, 2011, from Department of the Navy Budget Materials: http://www.finance.hq.navy.mil/FMB/09PRES/OMN_Vol1_book.pdf

Department of the Navy. (2011, February 1). *Fiscal Year 2012 Budget Estimates: Operation and Maintenance, Volume 1.* Retrieved February 15, 2011, from Department of the Navy Budget Materials: http://www.finance.hq.navy.mil/FMB/12pres/OMN_Vol1_book.pdf

Office of the Deputy Under Secretary of Defense (Installations and Environment). (2005, October). *An Executive Overview of the Facilities Operation Model.* Retrieved February 15, 2011, from Office of the Under Secretary of Defense for Acquisition: http://www.acq.osd.mil/ie/fim/programanalysis_budget/fo.shtml

Office of the Deputy Under Secretary of Defense (Installations and Environment). (2009, September 30). *Base Structure Report Fiscal Year 2010 Baseline.* Retrieved February 15, 2011, from Office of the Under Secretary of Defense for Acquisition: http://www.acq.osd.mil/ie/download/bsr/BSR2010Baseline.pdf

Office of the Deputy Under Secretary of Defense (Installations and Environment). (2007). *Defense Installations Strategic Plan.* Retrieved January 11, 2011, from Office of the Under Secretary of Defense for Acquisition: http://www.acq.osd.mil/ie/download/DISP2007_final.pdf

Office of the Under Secretary of Defense (Comptroller). (2009, March 30). *Financial Improvement and Audit Readiness Plan.* Retrieved April 2011, from Office of the Under Secretary of Defense (Comptroller): http://comptroller.defense.gov/FIAR/documents/FIAR_Plan_Mar_2009.pdf

OPNAV Instruction 5200.35. (2006, October 26). *OPNAV Performance / Pricing Models Policy and Procedures.* Retrieved March 15, 2011, from Department of the Navy: [http://doni.daps.dla.mil/Directives/05000%20General%20Management%20Security%20and%20Safety%20Services/05-200%20Management%20Program%20and%20Techniques%20Services/5200.35.PDF

R&K Solutions, Inc. (2010). *Facilities Operation Model, User's Manual, Version 12 (FY2012-2017).* Washington D.C.: R&K Solutions, Inc.

SECNAVINST 5200.38A. (2002, February 28). *Department of the Navy Modeling and Simulation Management.* Retrieved March 15, 2011, from Department of the Navy Issuances: http://doni.daps.dla.mil/Directives/05000%20General%20Management%20Security%20and%20Safety%20Services/05-200%20Management%20Program%20and%20Techniques%20Services/5200.38A.pdf

SECNAVINST 5200.40. (1999, April 19). *Verification, Validation, and Accreditation (VV&A) of Models and Simulations.* Retrieved March 15, 2011, from Department of the Navy Issuances: http://doni.daps.dla.mil/Directives/05000%20General%20Management%20Security%20and%20Safety%20Services/05-200%20Management%20Program%20and%20Techniques%20Services/5200.40.pdf

APPENDIX A. DETAILED DESCRIPTION OF THE 10 PRIMARY FUNCTIONS WITHIN THE FOM

(taken verbatim from the FOM User Manual[21])

1. Fire and Emergency Services. Is the protection of people, facilities, aircrews, aircraft, and other assets from loss due to fire and/or explosion. It includes Fire Protection Management and Administrative Support, Fire Operations, Fire Prevention, and Disaster Preparedness (DP). These categories encompass HazMat activities, personnel rescue capabilities, and preliminary Emergency Medical Services for Structural Fire Protection and Aircraft Rescue and Fire Fighting (ARFF). It includes all phases of fire protection planning and engineering, fire prevention, fire fighting (structural and crash), and related rescue services. It includes administration involved in maintenance of fire incident and operation records and reports. Operating fire-fighting facilities, alert services, and rescue operations is included. Fire & Emergency Services establishes and conducts training programs and plans and substantiates facilities, equipment, tools, supplies, and manning. It develops fire regulations and programs to reduce fire loss and to prepare for a range of rescue scenarios. The function includes fire hazard inspection reports and ensures fire extinguishers are installed, inspected and maintained in accordance with appropriate directives. (see DoDI 6055.6, ***DoD Fire and Emergency Services Program)*** **Excluded:** Does not include ambulance service provided by Tri-Care Medical Agency. Does not include the actual inspection, testing, and maintenance of fire detection and suppression systems.

2. Utilities. Includes operations of utility systems for the generation and distribution of all energy and source fuels, pneumatics, other gases, heated water, chilled water, potable and non-potable water, and ice. Includes purchase of all water, electricity, natural gas, sewage disposal, and other utilities (utility fuels, coal, coke, etc.). Includes issues of motor fuel, diesel fuel, distillates and residuals from installation fuel supplies for heating and power production for real property facilities equipment. Includes utility system privatization costs after the system has been privatized and Energy Savings Performance Contracts. The utilities activity is subdivided into two areas to allow FOM to more accurately model the requirement: ***Energy*** and ***Water & Waste Water***. Energy includes four major areas: (1) generation of utilities/operations of utility plants, (2) purchased energy (consumption), (3) utility privatization, and

[21] R&K Solutions, "Facilities Operation Model, User's Manual, Version 12 (FY2012–2017)," 1–5.

(4) Energy Savings and Performance Contracts (ESPC) and Demand Side Management (DSM) contract payments. Water & Waste Water includes domestic and industrial use sewage collection and treatment by a utility provider or through installation plant operations. **Excluded:** Facility and plant maintenance and scheduled, recurring repair other than operator maintenance is charged to Sustainment, PE ***78F or Restoration & Moderation, PE ***76 based on work classification. **Special Note:** Per DODI 4000.19, utilities are customarily reimbursable when provided to tenants and certain MWR Category C activities.

3. Pavement Clearance. Includes (1) Snow and ice removal from paved areas including streets, airfields, piers, walkways, and parking lots, and (2) Pavement sweeping of streets, parking lots, piers, airfield pavements, and walkways. Includes in-house and contract snow and ice removal and pavement sweeping including personnel, equipment, and supplies. Pavement sustainment is budgeted in PE ***78; Restoration & Modernization by contract is captured in PE ***76. **Special Note:** Street sweeping and snow removal are considered common services according to DODI 4000-19 unless the streets, airfields, walkways, and parking lots are for the exclusive use of the tenant or MWR Category C activity. In such cases, the cost may be reimbursed or direct cited if by contract.

4. Refuse Collection & Disposal: Accounts for all costs associated with refuse collection. includes: (1) Non-housing and housing, and (2) Recycling operations and administration. The non-housing and housing requirement includes disposal operations, trash collection, and disposal fees. In the recycling operations requirement, curbside pickup services and composting are included. **Excludes**: hazardous, biological, toxic, corrosive, reactive, flammable, radioactive wastes, and construction and demolition debris resulting from construction contracts. Also excluded are the recycling and composting programs paid by Environmental PEs.

5. Real Property Leases: Those leases that are in support of the installation commander's mission (for Military Departments) or the field activity director (for DoD Agencies/Activities), that in effect, expand the "footprint" of an installation. Applies to land leases (examples: security buffer space, runway clear zones, right-of-ways, etc.) and building space (examples: "downtown" office space, warehouse space, DoD dependent school rooms, etc.). May also include other forms of leased real property (examples: paved staging area, rail yard, runway, aircraft ramp space, dock, pier, etc.). Also includes costs that may be associated with out-leases. All FO leases must be posted to the one of the Military Department's Real Property Inventory (RPI) databases (or to the Washington Headquarters Service for leases within the National Capitol Area). (see DoDI 4165.14, ***Inventory of Military and Real Property*** and

DoDI 4165.70, ***Real Property Management***). **Excluded:** Those leases that are required to provide for a short-term need such as a peak or transitory mission requirement. Peak or transitory mission requirements are paid by the mission PE. Tenant requirements are budgeted by the tenant's command or agency in their FOM. Lease costs may be reimbursable to the host if the host provides.

6. Grounds Maintenance & Landscaping: Includes all associated landscaping activities, plant growth management of improved, semi-improved and unimproved land. ***Improved Grounds*** - land occupied by buildings and other permanent structures, as well as, lawns and landscape plantings on which personnel annually plan and perform intensive maintenance activities. Include the cantonment area, parade grounds, drill fields, athletic areas, green-belt along major roadways, installation entry points (primary and high use gates), picnic grounds within the cantonment area, memorials, and cemeteries. ***Semi-improved Grounds*** - Grounds where periodic maintenance is performed primarily for operational and aesthetic reasons (such as erosion and dust control, bird control, and visual clear zones for safety and/or security). This land use classification typically includes areas adjacent to runways, taxiways, and aprons; runway clear zones; safety and/or security zones (for example along fence lines); rifle and pistol ranges; weapons firing and bombing ranges; picnic areas outside the cantonment area; ammunition storage areas; missile sites; antenna facilities; industrial and fuel storage areas outside the cantonment area; staging and storage areas, remote or low use installation entry points, and shoulders of secondary roads. ***Unimproved Grounds*** - not classified as improved or semi-improved. Unimproved grounds include forestlands; croplands and grazing lands; lakes, ponds, and wetlands; and any areas where natural vegetation is allowed to grow unimpeded by maintenance activities other than an occasional thinning of brush and the creation of fire breaks for fire control. ***Pavement Sweeping*** of streets and sidewalks to remove grass and debris caused by grounds maintenance is included. ***Irrigation system*** maintenance within a grounds maintenance contract may be included in this activity to drain and charge systems, replace damaged or broken sprinkler heads, and to repair ruptured pipes. ***Re-lamping****:* replacement of light bulbs in landscape accent lighting or lighting along paths and walkways is included (usually less than 36 inches above the ground, does not include street lighting). ***Water features****:* operations and cleaning of manmade water features (i.e. ponds, waterfalls, and fountains) is included. **Excludes:** Establishing new landscaping as part of a Military Construction or an Operations & Maintenance facility project that is funded as a project cost. Excludes higher levels of irrigation system maintenance and repair that are accounted for in the Sustainment PE, ***78. Golf course grounds are not included, that is paid with non-appropriated funds.

7. Pest Control: Inclusive of all contracted and in-house (i.e. supplies, labor, training, admin costs) pest control and management. Includes facility & grounds, pest monitoring, pest response and removal, and installation pest education programs. Protects installation personnel from vector borne diseases and medical pests. Medical pests are animals that do not directly transmit a disease pathogen but are medically important because of biting, stinging, or other annoyance including secondary skin infection. (see DoDI 4150.7, ***DoD Pest Management Program)*** **Excludes:** herbicides applied through Grounds Maintenance Service Contracts.

8. Custodial: Inclusive of cleaning installation facilities and purchase of cleaning supplies (i.e. cleaners, waxes, toilet tissue, mops, brooms) Accounts for all activities associated with the management and costs for custodial (i.e. carpet cleaning, window washing, clean and stock bathrooms, and interior building replacement of light bulbs). Includes Civilian and Military Pay for administration and contract oversight. **Excludes:** Dormitory rooms that are cleaned by the occupants. **Special Note:** Custodial is considered a direct cost and may be provided to MWR Category C facilities and tenant units on a reimbursable basis. (See DoDI 4000.19 for host/tenant funding)

9. Real Property Management & Engineering Services: Includes (1) Facility Management and Administration and (2) Installation Engineering Services. Facility Management includes public works management costs, contract management, material procurement, facility data management (to include GeoBase), furnishings management costs, and real estate management. Installation Engineering Services includes annual inspection of facilities, master planning, overhead of planning and design, overhead of construction management, and non-Sustainment and Restoration Modernization (SRM) service calls. **Excludes:** In-house shop and contracted personnel who routinely perform facility Sustainment activities; design engineers, project managers, construction inspectors who manage and oversee facility sustainment and construction projects. Their positions are budgeted in PE ***78.

10. Readiness Engineering: Includes Disaster Preparedness, Explosive Ordnance Disposal (EOD) capability, and engineering combat support capabilities such as the Air Force's Base Engineer Emergency Force (Prime BEEF). Provides contingency support services to prepare for installation operations during natural disasters, major accidents, war, and other emergencies. This includes operational planning, base recovery training, and specialized equipment management. Responsible for engineering readiness support, peacetime disaster response, and contingency operations for all threat spectrums. This Function is only

applicable to the Military Departments and the requirement differs between Departments. Because this function is unique from the other nine functions in that it cannot be modeled based on real property data, FOM will look at using manpower and equipment data provided by the Departments to forecast the Readiness Engineering requirement. **Excluded:** Chemical and Biological Defense Program Management. Excludes disaster preparedness support provided by non-engineering partners such as Medical, Security, Services, Chaplin, Communications, etc. Their DP requirement is budgeted in their respective operations PE.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B. METHODOLOGY IN CONVERTING THE FOM RAW DATA INTO A REQUIREMENT FOR COMPARISON

Table 8 is an example of a FOM report that shows the operations requirement for energy for different Navy installations. The report lists what type of funding and what organization will pay for the requirement. An installation can have several different organizations paying for energy out of several different funding sources. Naval Support Activity Washington has five organizations (Navy Active, DECA, DODEA, DLA, and Other) forecasted to have an energy requirement to be paid from five different funding sources (Family Housing, O&M, NAF, WCF, and Other). In addition, Army and Air Force units stationed on Navy installations such as NAS Jacksonville reimburse the Navy for the use of electricity and ground maintenance. Almost every installation has a medical center, but the funding for those services is paid by Tricare Management Activity (TMA), not the DoN. The FOM includes all of those organizations in its forecast, but in order to compare the FOM forecast to PBIS, the organizations not included in PBIS must be removed. As a result, all requirement data that did not have a funding source of O&M and a funding organization of Navy Active was removed. Certain functions also had to be removed such as Engineering Readiness and Energy Management. Engineering Readiness is a function only used by the Air Force, and the costs for Energy Management are already included in the Real Property Management function for the DoN. Figure 9 provides a graphical representation of the methodology explained in Appendix B.

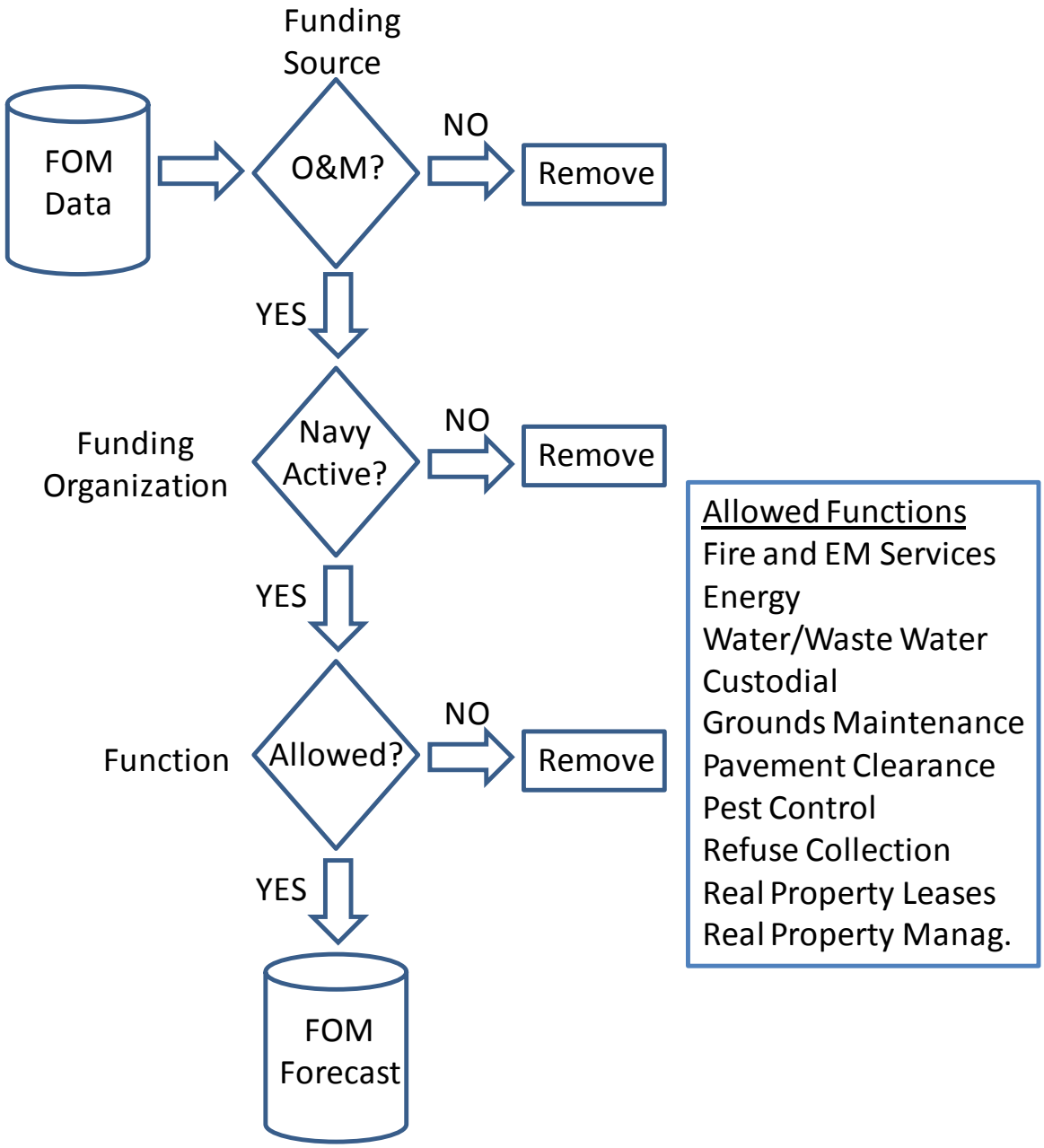

Figure 9. Methodology for Converting FOM Raw Data into the FOM Forecast for Comparison

Table 8. Excerpt of FOM Raw Data for FY2007

FOM FY07 REQUIREMENTS BY INSTALLATION - 13 JANUARY 2006								
FUNCTION	SERVICE	MAJCMD/REGION	MAJCMD/REGION NAME	INST CD	INSTALLATION NAME	OPERATIONS RQMT	SOURCE	ORG
ENERGY	N	N00018	BUMED	N69232	NAVBASE VENTURA CTY PT MUGU CA	6,150.99	OM	TMA
ENERGY	N	N00018	BUMED	N91571	ALLEGANY BALLISTICS LAB	670.79	OM	TMA
ENERGY	N	N00018	BUMED	N96095	NWIRP CALVERTON NY	1,054.37	OM	TMA
ENERGY	N	N00018	BUMED	OGRTEE	OUTGRANTEE	54,259.43	OM	TMA
ENERGY	N	N00052	COMMANDER NAVY INSTALLATIONS	N00207	NAS JACKSONVILLE FL	-42,774.04	OM	NV ACTIVE
ENERGY	N	N00171	NDW	LESSOR	LESSOR	11,220.34	OTHER	NV ACTIVE
ENERGY	N	N00171	NDW	M20364	CBIRF INDIAN HEAD DIVISION	1,238,775.39	OM	MC ACTIVE
ENERGY	N	N00171	NDW	N00025	NAVFACENGCOM WASHINGTON DC	68,491.95	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N00052	COMMANDER NAVY INSTALLATIONS	0.00	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N00167	NAVSURFWARCEN CARDEROCKDIV MD	4,313,062.81	WCF	NV ACTIVE
ENERGY	N	N00171	NDW	N00173	NRL WASHINGTON DC	16,398.12	NAF	NV ACTIVE
ENERGY	N	N00171	NDW	N00173	NRL WASHINGTON DC	8,943,105.79	WCF	NV ACTIVE
ENERGY	N	N00171	NDW	N00174	NAVSURFWARCENDIV INDIAN HEAD	49,613.98	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N00174	NAVSURFWARCENDIV INDIAN HEAD	12,325.09	WCF	DLA
ENERGY	N	N00171	NDW	N00174	NAVSURFWARCENDIV INDIAN HEAD	3,538,743.72	WCF	NV ACTIVE
ENERGY	N	N00171	NDW	N00178	NAVSURFWARCENDIV DAHLGREN VA	3,473,923.39	WCF	NV ACTIVE
ENERGY	N	N00171	NDW	N00421	NAVAIRWARCENACDIV PATUXENT MD	65,059.71	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N00421	NAVAIRWARCENACDIV PATUXENT MD	4,696,210.54	RDTE	NV ACTIVE
ENERGY	N	N00171	NDW	N00421	NAVAIRWARCENACDIV PATUXENT MD	4,874.54	WCF	DLA
ENERGY	N	N00171	NDW	N00421	NAVAIRWARCENACDIV PATUXENT MD	5,730,243.62	WCF	NV ACTIVE
ENERGY	N	N00171	NDW	N0428A	NAS PATUXENT RIVER MD	24,405.70	FH	NV ACTIVE
ENERGY	N	N00171	NDW	N0428A	NAS PATUXENT RIVER MD	108,813.95	NAF	DECA
ENERGY	N	N00171	NDW	N0428A	NAS PATUXENT RIVER MD	449,595.07	NAF	NV ACTIVE
ENERGY	N	N00171	NDW	N0428A	NAS PATUXENT RIVER MD	5,775,998.19	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N0428A	NAS PATUXENT RIVER MD	791,631.61	OTHER	NV ACTIVE
ENERGY	N	N00171	NDW	N0428A	NAS PATUXENT RIVER MD	21,531.85	WCF	DLA
ENERGY	N	N00171	NDW	N45854	FLTSURVEILLANCE SPT CMD	0.00	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N61897	NAVRESCEN BALTIMORE MD	20,355.49	OM	NV RESERVE
ENERGY	N	N00171	NDW	N62472	NAVFAC EFA NORTHEAST	164,933.85	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N63039	NAVRESCEN ADELPHI MD	5,232.61	OM	NV RESERVE
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	1,249,583.17	FH	NV ACTIVE
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	75,539.49	NAF	DECA
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	294,827.13	NAF	NV ACTIVE
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	35,754.26	OM	DODEA
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	25,825,555.52	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	0.00	OM	OTHER
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	-54,323.02	OTHER	NV ACTIVE
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	0.00	OTHER	OTHER
ENERGY	N	N00171	NDW	N68469	NAVAL SUPPORT ACTIVITY WASH	52,060.50	WCF	DLA
ENERGY	N	N00171	NDW	N68925	PWC WASHINGTON DC	1,040.22	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N68925	PWC WASHINGTON DC	169.96	OTHER	OTHER
ENERGY	N	N00171	NDW	N68925	PWC WASHINGTON DC	1,163,358.85	WCF	NV ACTIVE
ENERGY	N	N00171	NDW	N69171	CARDEROCK MD NSWC CSO	0.00	NAF	NV ACTIVE
ENERGY	N	N00171	NDW	N69171	CARDEROCK MD NSWC CSO	0.00	OM	NV ACTIVE
ENERGY	N	N00171	NDW	N69171	CARDEROCK MD NSWC CSO	0.00	WCF	DLA

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C. REGRESSION ANALYSIS OF FOM AND PBIS

Table 9. Regression Summary Output for FOM / PBIS Totals

Regression Statistics	
Multiple R	0.101376121
R Square	0.010277118
Adjusted R Square	-0.484584323
Standard Error	116.4584694
Observations	4

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	281.6630516	281.6630516	0.020767668	0.898623879
Residual	2	27125.15017	13562.57509		
Total	3	27406.81322			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1680.385586	387.5816782	4.335565071	0.049298754
FOM	0.039059532	0.271039866	0.144109915	0.898623879

Table 10. Regression Summary Output for FOM / PBIS Fire and Emergency Services

Regression Statistics	
Multiple R	0.96529024
R Square	0.931785247
Adjusted R Square	0.897677871
Standard Error	9.827495919
Observations	4

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2638.476691	2638.476691	27.31917106	0.03470976
Residual	2	193.1593521	96.57967604		
Total	3	2831.636043			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	10.45793448	68.99938637	0.151565616	0.893437172
FOM	1.129802948	0.216156821	5.226774441	0.03470976

Table 11. Regression Summary Output for FOM / PBIS Utilities

Regression Statistics	
Multiple R	0.577125626
R Square	0.333073988
Adjusted R Square	-0.000389018
Standard Error	53.1555857
Observations	4

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2822.220042	2822.220042	0.998833399	0.422874374
Residual	2	5651.032583	2825.516291		
Total	3	8473.252625			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	928.8801401	138.749407	6.694660254	0.021592201
FOM	-0.226645529	0.226777847	-0.99941653	0.422874374

Table 12. Regression Summary Output for FOM / PBIS Facility Services

Regression Statistics	
Multiple R	0.753684541
R Square	0.568040387
Adjusted R Square	0.352060581
Standard Error	23.87225238
Observations	4

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1498.831671	1498.831671	2.630062487	0.246315458
Residual	2	1139.768868	569.8844338		
Total	3	2638.600539			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	335.9644686	43.76124154	7.677215198	0.016546577
FOM	-0.313925143	0.193572236	-1.62174674	0.246315458

Table 13. Regression Summary Output for FOM / PBIS Facility Management

Regression Statistics	
Multiple R	0.688567167
R Square	0.474124744
Adjusted R Square	0.211187116
Standard Error	35.9817539
Observations	4

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2334.557299	2334.557299	1.803183314	0.311432832
Residual	2	2589.373227	1294.686614		
Total	3	4923.930527			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	225.126109	62.11052468	3.62460485	0.068399195
FOM	0.287668977	0.214226449	1.342826614	0.311432832

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, VA

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, CA

3. Professor Daniel Nussbaum
   Naval Postgraduate School
   Monterey, CA

4. Professor Raymond Franck
   Naval Postgraduate School
   Monterey, CA

5. Professor John Mutty
   Naval Postgraduate School
   Monterey, CA

6. CDR Eric Hawn
   FMB127 /OPNAV N82
   Department of the Navy
   Washington, D.C.